

SOME REFLECTIONS ON THE ROLE OF THE SCIENTIFIC ADVISORY PANEL TO THE MARSHALL ISLANDS NATIONWIDE RADIOLOGICAL STUDY

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Abstract—As a consequence of the U.S. Atomic Weapons Testing Program in the Trust Territory of the Pacific, now the Republic of the Marshall Islands, numerous scientists have advised the Marshallese on matters of radiation and radioactive contamination. Some of the previous advice has appeared to vary or conflict resulting in consequent uncertainty for the people. In a new initiative in 1989, the RMI Government engaged a five member multi-disciplinary Scientific Advisory Panel to oversee the assessment of, and to advise on, the radiological status of the entire nation. The formation of the Panel was accompanied by the establishment of a Resident Scientist position, and ultimately a small scientific team and laboratory on Majuro. The nationwide radiological study was conducted using ground survey methods over the period 1990–1994. Tasks undertaken by the Panel included formulating reasonable objectives for the study and attempting to establish effective communication and understanding of issues with political leaders and RMI Government agencies and people, as well as advising on and monitoring the scientific integrity of the study itself. The attempt was also made to initiate investigations to address matters of concern that emerged. The problem was faced of providing not only technical guidance on radioactivity and radiation measurements, but also explaining the significance of measured values and concepts, such as risk and probability of health effects to a diverse but nontechnical audience, generally across cultural and language barriers. The experience of the Panel in providing advice and guidance to the Republic of the Marshall Islands, while unique in many ways, parallels the difficulties experienced elsewhere in communicating information about risks from radiation exposure.

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HISTORICAL CONTEXT AND BACKGROUND

Enewetak and Bikini atolls in the northern Marshall Islands were used as bases for a series of nuclear weapons tests conducted by the U.S. over the period 1946–1958. One of these tests, designated Castle BRAVO, which took place on 1 March 1954, deposited heavy radioactive fallout on the islands of Rongelap atoll about 160 km to the east of Bikini, and, at a lower level, on the islands of Utirik further to the east.

About 50 h after the BRAVO detonation, the U.S. Navy removed the 64 Rongelap residents from Rongelap Island and another 18 residents who were visiting Sifo Island, Alinginae Atoll. A further 157 residents were later removed from Utirik Atoll. The Rongelap Island exposed group received external radiation doses estimated to have been about 1.9 Sv and thyroid doses from ingestion of iodines estimated at between about 50 Sv for a 1-y-old child to about 12 Sv for an adult.

Doses to Utirik residents were only of the order of one tenth of those to residents on Rongelap Island, and these residents were returned to Utirik a few months later. Rongelap Islanders did not return to Rongelap until 1957. In March 1958, there were 81 persons there who had been exposed in 1954 on Rongelap or Alinginae, and about another 100 who were not.

The USAEC commissioned Brookhaven National Laboratory's Medical Division to establish a medical follow-up program for the exposed group. Visits continue to be made, with the primary finding being damage to the thyroid gland with, in particular, increased incidence of thyroid nodules. The late appearance of thyroid effects and one case of acute leukemia worried the Rongelap people, as did measurements made on Bikinians who had returned to their atoll after the nuclear tests. These measurements showed somewhat higher than expected body burdens of ¹³⁷Cs. The Rongelap people therefore abandoned Rongelap again in 1985, and a community has been resident on Majetto Island on Kwajalein Atoll. Resettled Bikinians had been removed to Kili Island in 1978.

A detailed assessment of the radiological status of the Northern Marshall atolls was made by the U.S. Department of Energy (DOE) in 1977–1978. External radiation levels were measured using airborne (helicopter) instruments (EG&G 1981), and soil and other samples were taken for radioactivity analyses (Robison et al. 1981a). From these measurements, which were reported to the Marshallese people (DOE 1982), dose estimates were made for resident populations (Robison et al. 1981b; Noshkin et al. 1981; Robison et al. 1982).

A study of the incidence of thyroid nodules in Marshallese by place of residence in 1954, published in 1987 (Hamilton et al. 1987), appeared to show an elevated incidence of thyroid nodules outside the region that had been surveyed by the U.S. DOE in 1977–1978. This increased distrust of the DOE, and DOE survey work, led to calls for further monitoring.

NATIONWIDE RADIOLOGICAL STUDY

Under Section 177 of the Compact of Free Association (U.S. Public Law 99-239) between the Republic of the Marshall Islands and the United States, funding was established to compensate displaced atoll communities and, through a Nuclear Claims Tribunal, to provide for compensation of any individuals who had suffered personal injury or loss of or damage to property as a result of the testing program. Some limited funding was also provided under the Compact for further radiological studies. In 1989 the Marshall Islands Government resolved to undertake further investigations into the extent of residual fallout and the effects on the Marshallese population. These new radiological studies were at least partly motivated by the wish to have evidence that could support or refute claims for compensation made to the Nuclear Claims Tribunal.

A five member Scientific Advisory Panel comprising two health physicists, two radiation biologists and a radiation geneticist, together with a Resident Scientist, were selected by the Office of the Chief Secretary and the Nuclear Claims Tribunal. Of those selected only the Resident Scientist (SLS) was a U.S. citizen, to avoid any association with previous advice from U.S. agencies. Subsequently the Panel recommended that an environmental radioactivity laboratory be constructed in Majuro to serve as a base for the resident scientific survey team. The laboratory, which began operation in 1991, had radiochemical facilities and gamma and alpha counting equipment.

At the first meeting of the Advisory Panel in November 1989, a set of objectives for the study was defined that changed only slightly subsequently. Briefly, these were as follows:

1. To establish the extent of fallout radioactivity throughout the nation and determine the past and present levels;
2. To reassess the radiological conditions of Rongelap and Utirik Atolls;

3. To advise on effects associated with the derived radiation exposure levels;
4. To advise and assist the Nuclear Claims Tribunal in the determination of whether an individual's particular disease, illness or property damage was caused by the US Nuclear Testing Program or provide other information and/or advice which may be defined at a later date; and
5. To provide information to the public of the Marshall Islands which explains and clarifies the findings of this study and to participate in educational activities concerning radiation and radioactivity, and its potential health and environmental effects.

The Scientific Advisory Panel to the Nationwide Radiological Study followed a succession of largely atoll-specific advisory committees, and indeed operated contemporaneously with some individual advisers and a Rongelap advisory committee. It did, however, for the first time have oversight of a major radiological study involving the whole of the Marshall Islands. The study therefore necessarily overlapped in scope with prior studies. The findings were reported in brief to the RMI Government (Simon and Graham 1994) and are presented in detail in this issue (Simon and Graham 1997). This paper reflects on the role of the multi-disciplinary Advisory Panel and, in particular, experiences of the Panel in attempting to establish effective communication and understanding of issues with the RMI Government, government agencies and Marshallese people.

Given the budgetary constraints, planning proceeded with a ground-based radiological survey in mind, using *in-situ* gamma-spectrometry to determine the concentrations of gamma emitting radionuclides (principally ¹³⁷Cs) in the soil. The logistical problems associated with surveying all significant islands of all atolls by small survey parties resulted in the study extending over several years. As much as was possible, Marshallese were employed as staff to support survey work and to provide support laboratory services in an endeavor both to broaden local involvement in the study and assist in providing local employment and training opportunities. The sample analysis and counting was all undertaken at the RMI laboratory in Majuro. It was hoped that this involvement, and the fact of the study base being within the Marshall Islands, would aid ownership both of the study and its results by the Marshallese people.

THE PANEL'S WIDER ROLE

Apart from its major role in advising on the objectives of the nationwide study, the scope and methodology of measurements, and monitoring the study's scientific integrity and progress, attempts were made at an early stage to meet and explain the objectives of the study to the public and government officials. Meetings were held with the RMI Nuclear Claims Tribunal, the Cabinet, Nitijela (parliament), and local press, and public meetings were convened at Majuro, Ebeye and Mejjatto. (Majuro, and Ebeye island on Kwajalein Atoll are the

largest centers of population, and part of the Rongelap community is resident on Mejjatto island, also in Kwajalein Atoll.) These meetings had a common purpose of introducing the Panel and Resident Scientist to the different groups and outlining the study objectives and types of information that would be obtained. The public meeting in Majuro, in particular, was poorly attended, although the session was videotaped and aired at least twice on local television. Meetings of this type did not appear to be particularly effective for communicating an understanding of radiation issues, such as the significance of radioactivity or exposure levels. The Marshallese people are aware of many scientists having come and gone in the past, and it appeared essential for effective communication that a base of adequate time, repeated visits and a degree of familiarity was established for there to be trust and acceptance. For people with very limited understanding of radioactivity and radiation physics, and no words to express such concepts in their language, trust in the messenger may be more important than the message for its acceptance. In the outer atolls in particular, social interaction with visitors is of importance, as is respect shown to residents as owners of the atoll. Individual panel members accompanied ground survey parties on visits to five of the outer atolls.

Recurring questions that arose at these meetings were the background and expertise of the panel members, the time scale of the study (particularly having in view its perceived link to the Nuclear Claims Tribunal compensation strategy and payments), and whether the money available was adequate for the purpose of a comprehensive study. The latter question arose against the background of the 1977–1978 DOE study of the northern Marshalls for which the costs were very much greater. A more specific concern raised at Mejjatto was that the continuing late presentation of thyroid nodules was related to current levels of contamination rather than exposure in 1954. The development of late effects clearly engendered anxiety about present contamination.

A continuing dialogue with the Nuclear Claims Tribunal was held throughout the course of the study. Two significant areas of concern on which the Tribunal requested advice were conditions which could be presumed to be caused by radiation exposure and a mechanism by which compensation could be awarded for claims on land contamination. Though the Nuclear Claims Tribunal requested detailed advice and guidance, in the end few if any of the recommendations of the Panel were implemented. In particular, the list of compensable medical conditions decided upon by the Claims Tribunal was more expansive than was suggested by the Panel as having firm evidence as likely radiogenic conditions. Other suggestions by the Panel to use probability of causation methods to determine financial awards and a plan to develop equitable compensation for "land damage" (principally contamination) were also not adopted.

One of the reasons underlying the establishment of the Nationwide Radiological Study was the report by

Hamilton et al. (1987) that there is pronounced heterogeneity of the prevalence of thyroid nodules in the Marshall Islands among those living during the nuclear test period, with prevalence varying with distance from Bikini. As an extension of the radiological monitoring of all atolls and islands, the Panel proposed a further study to test Hamilton's hypothesis and seek to establish whether causes other than radiation might be contributing to an apparently high incidence of thyroid nodules and cancers in the Marshallese population. The study proposed was an investigation of the prevalence of benign thyroid nodules, thyroid cancer and hypothyroidism with atoll of residence during the weapons test program, and comparison with prevalences of these conditions with atoll of residence in a control population born after radioiodine from the tests had decayed. Establishing this study met with considerable difficulties in acceptance, as well as logistics, with health officials originally perceiving it as an unnecessary expenditure of funds, which, in their view, could have been expended more usefully in providing other health services, and some resistance from others based on a perception of the Marshallese people being further treated as guinea pigs for scientific studies. Even more remarkable was that some health officials viewed a comprehensive thyroid study as potentially disproving any association between thyroid disease and radiation exposure, thus eliminating hopes for additional compensation. In spite of these difficulties, during 1993–1994, over 6,500 Marshallese were examined for evidence of thyroid abnormalities. Though data analysis is not yet complete enough to allow conclusions to be drawn, the medical findings have been described (Takahashi et al. 1997) and appear to indicate disease rates that may be unusually high and warrant further examination.

Another area proposed for investigation arose from a concern of the Rongelap community that children resident on Rongelap on their return to the island might ingest sufficient plutonium in soils to receive appreciable doses from this route. On the face of it, taking account of measured soil concentrations and likely intakes, it appeared unlikely to be a major contributor to exposure. However, consideration was given to carrying out measurements of infant soil ingestion rates for coralline soils and the general living conditions of the outer atolls (Simon et al. 1994). Some investigations carried out in conjunction with the Rongelap Resettlement Project had included exhuming, with the agreement and cooperation of community members, the bones of some former residents of Rongelap, and assessing the plutonium content of bone samples. The extremely low measured concentrations gave additional confidence that ingestion of plutonium was not a significant source of exposure (Franke et al. 1995). Ultimately, for logistical reasons the infant soil ingestion study was not able to be performed, but it was concluded that the intake of actinides by soil ingestion was not likely to be more than a minor contributor to infant doses.

PRESENTING THE STUDY FINDINGS

A presentation of the findings of the study was made to the President and Cabinet by the Panel and Resident Scientist in December 1994. A presentation was also made to the Nuclear Claims Tribunal, and copies of the Summary Report (Simon and Graham 1994) were made widely available. The local press gave extensive coverage to the results and conclusions. Distribution of the Summary Report was followed by individual atoll community reports in both English and Marshallese. In a foreword to the Summary Report the Panel wrote: "We believe that the current levels of radioactive contamination of the territory of the Marshall Islands pose no risk of adverse health effects to the present generation. Similarly, on the basis of current genetic knowledge, we judge the risk of hereditary diseases to future generations of Marshallese to be no greater than the background risk of such diseases characteristic of any human population."

Four atolls have been identified where exposure rates are elevated to the extent that remedial actions are indicated for some islands.

There are indications that the prevalence of thyroid disease in the Marshall Islands may be higher than in some other countries. While there is a well recognized association with exposure to fallout radio-iodines, which has given rise to elevated rates in the 1954 Rongelap and Utrik populations, the amount of variation in prevalence throughout the Marshalls, and the overall level, remains to be determined. The conduct of the thyroid study therefore has the potential to give important new information on the rate of thyroid disease in the Marshall Islands, as well as allowing inferences to be drawn on the extent to which fallout radio-iodines may have contributed."

In the Summary Report attempts were made to respond with simple explanations to questions commonly asked and to set the exposure levels reported in an understandable context. Some Marshallese do not accept comparisons made between derived exposure levels and background radiation rates, which are commonly used as a basis of comparisons in other contexts. This is because they adopt the view that exposure from radioactive fallout is all additional to the assumed low natural levels that they and their ancestors have experienced. The comparison between radiation exposure levels and risks incurred with smoking and the risks this habit carries, was therefore emphasized. Smoking one pack of cigarettes a day carries a risk more than 100 times greater than an exposure level of 1 mSv y^{-1} (100 mrem y^{-1}). The impact of this comparison, however, may have been only poorly appreciated as many Marshallese may not be well informed on the causative association between smoking and adverse health outcomes. The level of natural background radiation in the Marshall Islands, however, was also referred to. For atolls it has commonly been assumed in the past that natural radiation exposure arises almost entirely from cosmic rays, because of the absence of significant terrestrial radioactivity and radon. The study by Noshkin et al. (1994), however, on dietary

intake of ^{210}Po and ^{210}Pb from sea foods, indicates annual doses from this source of about 2 mSv in the Marshalls. Annual doses from natural sources in the Marshalls may therefore be little different from many continental areas. The amount of seafood in diet could give rise to greater variation in annual doses than the 1 mSv y^{-1} accepted as a basis for Rongelap resettlement. This comparison caused problems of acceptance by the Marshallese community because the background exposure rates cited were significantly different from what had been previously understood.

As in other communities there was again the perceptual difficulty of interpreting any limit proposed or set as anything other than a boundary between "safe" and "unsafe," rather than as a point on a scale of risk. Attempts were therefore made in discussion to indicate that the benefits of resettlement of a community expected to incur dose rates of a few mSv y^{-1} would far outweigh the risk, if there was a genuine desire to return. Reluctance or tardiness in taking steps towards resettlement may, however, be related not only to anxieties about risk but also to compensation eligibility and magnitude.

The findings of the Nationwide Radiological Study (Simon and Graham 1994) summarized in the Panel comments above, and given in more detail elsewhere in this issue (Simon and Graham 1997), were not universally accepted. Indeed, a Nitijela resolution (Nitijela 1995), to which the Panel responded (McEwan 1995), was both formulated and passed, rejecting the findings. This resolution, in its reasons for rejection and explanations, showed obvious misunderstanding of the methods and results of the study and reflected a lack of effort and perhaps willingness on the part of the proposers in attempting to study and understand the results. This negativity may have arisen from a sense of hurt, or wish for compensation, from the nuclear tests and fallout, which in the perception of the resolution proposers did not appear to be sufficiently supported or corroborated by the study findings, or from a feeling of deep and long standing distrust of any scientific evaluation of the situation in the Marshall Islands. As with the Chernobyl affected population in the former USSR, there is a widespread belief that most illness is traceable to radiation effects, which may make any discussion on scientific facts difficult, if not impossible.

Two persistent rumors in the Marshalls are the attribution of poor arrowroot crops and the delivery of "jelly babies" to radiation effects. The apparent poor productivity of arrowroot after returns to formerly evacuated areas has been traced to the lack of cultivation of the soil over the intervening years, and perhaps also to loss of knowledge of cultivation requirements (Spennemann 1992). "Jelly babies" are grossly deformed, sometimes limbless fetuses which have been born not only in the Marshalls but also in French Polynesia (Sunday Times Star 1995) and have been considered to be the result of exposure to radiation. Possible causes are viral or other infections, toxic fish or other poisoning, or genetic causes.

CONCLUSIONS

It is the Panel's view that the Nationwide Radiological Study has provided a comprehensive and soundly based survey of the radiological status of the Marshall Islands. However, a less successful aspect of the study has been the ability to convey an understanding and perspective of the findings to the RMI government and people. It would be most regrettable if, after concluding this major study, the results were not incorporated in constructive future planning, or worse, set aside on the flimsy grounds of not satisfying preconceptions or falling in line with political agendas.

The findings of the study are consistent with recent reports from Lawrence Livermore National Laboratory (LLNL) for Bikini Atoll (Robison et al. 1995), not only in measured soil and plant concentrations but also in the assessment of doses to resident populations, although the dietary models used were developed quite independently. The findings of both the Nationwide Radiological Study and the LLNL reports were endorsed by an IAEA international Advisory Group which met in December 1995 and reassessed options for intervention measures on Bikini Island (IAEA 1996).

It is perhaps not an uncommon experience of advisory groups that political constraints, lack of cooperation and support, and lack of acceptance of the findings can lead to a certain disillusionment with participation in such groups. While the experience of the RMI's Scientific Advisory Panel was unique in many respects, the difficulties in communicating information about risks from radiation exposure, and the conflict with political strategies, are common to experience elsewhere.

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